Intel in High Density Data Centers and Cloud Computing

Nam Thieu
National Sales Manager, MNC and Channel

Legal Disclaimer

- Intel may make changes to specifications and product descriptions at any time, without notice.
- Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, visit Intel Performance Benchmark Limitations.
- Intel does not control or audit the design or implementation of third party benchmarks or Web sites referenced in this document. Intel encourages all of its customers to visit the referenced Web sites or others where similar performance benchmarks are reported and confirm whether the referenced benchmarks are accurate and reflect performance of systems available for purchase.
- Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families. See www.intel.com/products/processor_number for details.
- Intel, processors, chipsets, and desktop boards may contain design defects or errors known as errata, which may cause the product to deviate from published specifications. Current characterized errata are available on request.
- Intel Virtualization Technology requires a computer system with a processor, chipset, BIOS, virtual machine monitor (VMM) and applications enabled for virtualization technology. Functionality, performance or other virtualization technology benefits will vary depending on hardware and software configurations. Virtualization technology-enabled BIOS and VMM applications are currently in development.
- 64-bit computing on Intel architecture requires a computer system with a processor, chipset, BIOS, operating system, device drivers and applications enabled for Intel® 64 architecture. Performance will vary depending on your hardware and software configurations. Consult with your system vendor for more information.
- Intel, Intel Xeon, Intel Core microarchitecture, and the Intel logo are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.
- © 2008 Standard Performance Evaluation Corporation (SPEC) logo is reprinted with permission
A Rapidly Evolving Internet

Explosion in IP Traffic

- 11K in 2008
- 55K in 2013

Richer Services, Dynamic Apps

Proliferation of Devices

Requiring More Infrastructure

- Apple picks NC for $1B Data Center
  - June 2009
- Amazon Building Large Data Center in Oregon
  - Nov 2008
- Study: Datacenter Supply at an All-Time Low
  - May 2009

Internet and Cloud Datacenters

Requirements

- Massive scale
- Customized solutions
- Multi-tenancy
- Low TCO

Cloud datacenters require extreme efficiency to maximize datacenter use and lower TCO while maintaining performance and SLAs
Internet and Cloud Datacenters
Require Low TCO and Extreme Efficiency

Efficiency and performance gains derived from:

- Optimized servers and platform components
- Improved power management and reduced power consumption
- More efficient virtualization
- Software tuning
- Datacenter level optimizations

Cost of Typical Major Internet Datacenter

Source: Intel internal analysis, 2008 of 3 yr TCO

Intel Optimization Strategy

Intel focused on innovating and optimizing for cloud & internet datacenters
Comparing TCO Optimization Areas

Theoretical ROI Estimates of Datacenter Optimizations – 5000 Server Deployment

10% PUE Improvement

Could save:

~ $600K in power & cooling

Specify World Class Power Supplies

Could save:

~ $800K in power & cooling

Select High Performance CPUs That Allow 20% Fewer Servers

Could save:

~ $1M in power & cooling

~ $3M in CAPEX

Choosing the right CPU may be the most critical optimization

Source: Intel internal analysis; refer to backup for detailed info on calculations

Intel® Xeon® 5500-based Servers

Optimized for the Cloud

Intelligent Performance

• Up to 125% higher compute performance

Energy Efficiency

• Automated power states
• ~50% lower idle power
• Higher operating temperature

Dynamic Virtualization

• Up to 2X virtualization performance
• Enhanced I/O virtualization

† Up to 125% higher compute performance, 50% idle power, and up to 2X virtualization performance are based on comparison to previous generation 5400 series. Lower cooling cost based on Intel internal analysis (January 2009). For detailed calculations, configurations and assumptions refer to the legal information slide in backup.

* Other names and brands may be claimed as the property of others. Copyright © 2009, Intel Corporation.
Value of Transitioning to New Platform

**nhn.**

- Operates Korea’s #1 search portal
- 1 billion page views per day
- Leading online game portal, Hangame*

**IT Challenges**
- Use optimal platform for high traffic
- Reliability required for 24/7 operation
- Improve service performance

**Solution**
- Intel® Xeon® 5500 series platform

**Results**
- Over 40% improvement in throughput†
- Over 300% reduction in response time†
- See NHN video on use of Intel Xeon 5500 series: http://www.intel.com/references/audiovideo.htm

**KDDI**

- Leading Japanese telco
- Introduced Cloud Server Service

**IT Challenges**
- Offer highly reliable cloud service
- Increase rack density

**Solution**
- Intel® Xeon® 5570 platform, Intel® Virtualization Technology, Intel® Intelligent Power Technology

**Results**
- Increase rack density about 40%†
- Ability to expand outsourcing business due to high performance of virtualized servers

**Full case study:**
http://communities.intel.com/docs/DOC-4051

---

† Compared to previous generation servers

Customer success and results are specific to the customer, its business goals and the configuration of its enterprise environment. Differences in business goals, software design, infrastructure or configuration may affect actual results.

* Other names and brands may be claimed as the property of others. Copyright © 2009, Intel Corporation.
Intel Optimization Strategy

Optimized Silicon  Optimized Technologies  Scalable Software  Optimized Systems  Datacenter Optimization

Intel focused on innovating and optimizing for cloud & internet datacenters

Extreme Efficiency: Power Management

1. Power Monitoring:
   - Real-time power consumption
   - Avoid datacenter hotspots
   - Thermal / Power aware scheduling

2. Increase Rack Density:
   - Enable higher density with power capping

3. Power Savings:
   - Workload based power-tuning

4. Business Continuity:
   - Prolong operation during DC outage

Multiple Usages Drive Need for New Solutions

* Other names and brands may be claimed as the property of others. Copyright © 2009, Intel Corporation.
Power Management Technologies

**Intel® Intelligent Power Node Manager**
- Monitors and reports system power
- Caps system power to policy
- Dynamically adjusts P & T-states

**Intel® Dynamic Power Data Center Manager**
- Scales Intel Node Manager functions to rack level
- Aggregates data and reports trends
- Dynamically adjusts power caps

---

Data Center Power Management

**Monitor and Control Server Power**
- Report system level power
- User-defined input to control individual SERVER power consumption

**Manage and Coordinate at the Data Center Level**
- Control total power dissipation in each ROW (e.g., 95kW due to CRAC)
- Control power used by each RACK (e.g., 6kW due to circuit breaker)

Intel driving dynamic power management capabilities at all levels
World Class Power Management Solutions

Broad Industry Support and Growing Adoption For Intel® Node Manager

End Users

OEM, ODM & Console Providers

* Other names and brands may be claimed as the property of others. Copyright © 2009, Intel Corporation.

Reducing Power Consumption, Increasing Density

IT Challenges

• Increase compute density
• Manage power consumption
• Increase # of servers per rack
• Reduce costs of power/cooling

Solution

• Intel® Xeon 5500 series platform, plus Intel® Node Manager

Results

• 35% energy savings¹
• 50% more servers into existing rack using same power envelope¹
• Full case study: http://communities.intel.com/docs/DOC-4230

¹ Compared to previous generation servers

* Other names and brands may be claimed as the property of others. Copyright © 2009, Intel Corporation.

#1 search engine in China

IT Challenges

• Maximize # of servers per rack
• Optimize power utilization given power constraints

Solution

• Intel Xeon 5500 series, plus Intel Node Manager and Data Center Manager

Results

• 40%+ increase in rack density
• Maintain needed performance levels
• Improve power mgmt/consumption
• Full case study: http://communities.intel.com/docs/DOC-4230


* Other names and brands may be claimed as the property of others. Copyright © 2009, Intel Corporation.
The Role of Virtualization

Prior Innovations

- **Binary Translation**
  - Performance Increases with Virtualization Optimizations

- **Clustering Technology**
  - Higher Availability
  - Homogeneous Resource Pools

- **Virtualization Instructions**
  - Consolidation & VM Migration

...Cloud Advances

- **Near Native Performance and Scalability**

- **Continuous Availability**

- **Rules based resource allocation**

Virtualization Enables Flexible Elasticity

Intel® Virtualization Technology

**A Platform of Virtualization Technologies**

**Intel® Virtualization Technology**

- **Intel® VT-x**
- **Intel® VT For Directed I/O (Intel® VT-d)**
- **Intel® VT For Connectivity (Intel® VT-c)**

- Processor
- Chipset
- Network

Performance with Page Table Optimizations
Flexibility in Live Migration

I/O Performance Through Direct Assignment
Memory Protection

Over 2x Throughput Gains on 10GbE
Offload Routine I/O Tasks

Intel hardware optimizations are enabling all virtualization use models

1 Source Intel: Throughput measures receive side (Rx) I/O performance of 10GbE LAN.
**Intel® Xeon® Processors 5500 Series on Xen**

*Ideal for Virtualized Cloud Architectures*

**Virtualization Performance on vConsolidate**

SLES 11 RC1 (Xen 3.3.1)

- Up to 2.12X higher performance with Xen virtualization*
- ~40% lower roundtrip virtualization latency
- End-to-end hardware virtualization advantage

![Graph showing relative performance comparison]

**Higher performance means supporting more VM’s per server**

*Other names and brands may be claimed as the property of others. Copyright © 2009, Intel Corporation.

---

**Intel Optimization Strategy**

- Optimized Silicon
- Optimized Technologies
- Scalable Software
- Optimized Systems
- Datacenter Optimization

**Intel focused on innovating and optimizing for cloud & internet datacenters**

*Other names and brands may be claimed as the property of others. Copyright © 2009, Intel Corporation.
Scalable Software

Intel Software Tools

• Removing bottlenecks
• Training
• Optimizing for power efficiency

Cloud Computing Development

• Open Cirrus™ Cloud Computing Testbed
• Reference architecture development
• Technology integration for Cloud Operating Environments

DCMI = Data Center Manageability Interface

• Simplify management for large datacenters
• Increase interoperability across vendors, platforms
• Boost consistency and reliability for server scale
• DCMI v1.0 published June 2008
• Endorsed by Dell, FSC, HP, MSFT, Rackable, Verari, ZT

Building a Cloud Environment

So many options. So little time.

Lower cost  More agile  More capacity

Servers  Storage  Network  Power  Cooling  HW mgmt  Cloud SW  Applications

Security  Support  Availability  Lock-in  Standards

Starting from a known design would simplify the design process

* Other names and brands may be claimed as the property of others. Copyright © 2009, Intel Corporation.
**Intel® Cloud Builder Program**

*A Starting Point from Which to Build a Cloud Solution*

- Intel HW Blueprints
- ISV Cloud SW Stack
- Test Bed
- Integrated solution
- Software Reference Architecture
- White Papers
- Webinar/Training

For more information: [http://communities.intel.com/docs/DOC-4292](http://communities.intel.com/docs/DOC-4292)

---

**Intel Optimization Strategy**

- Optimized Silicon
- Optimized Technologies
- Scalable Software
- Optimized Systems
- Datacenter Optimization

Intel focused on innovating and optimizing for cloud & internet datacenters

* Other names and brands may be claimed as the property of others. Copyright © 2009, Intel Corporation.
**Balanced Platform Technologies**

**Compute**

Intel® Xeon® 5500 platform with enhanced compute and I/O virtualization

**Result:**

- Workload agility
- Simpler and lower cost
- Performance for on-demand scalability

**Network**

10Gb Ethernet with built-in support for unified fabric

**Storage**

Open platforms and performance breakthroughs (SSDs)
## Platform Optimizations

### Board Optimizations
- Fewer components
- Less shadowing = better airflow
- High efficiency voltage regulators

**Impact**
- Reduce power consumption
- <60W idle power
- Leadership SPECpower result

### Network Optimizations
- Unified networking
- Eliminate switches/cables
- Scalable with multi-core CPUs

**Impact**
- Up to 10X increase I0 bandwidth
- >5X port count reduction
- Up to 4.5X power per Gb reduction

### Solid State Drives
- Lower power consumption
- No moving parts
- Dramatic performance increases

**Impact**
- Up to 46X lower power
- Lower TCO (fewer drives)
- Up to 6X read perf improvement

---

**Notes:**
1. Source: spec.org postings as of July 15, 2009
2. Based on Intel internal results. Actual results may vary significantly based on workload and product configurations. See backup for more details on the results.

---

* Other names and brands may be claimed as the property of others. Copyright © 2009, Intel Corporation.

---

## Achieving Performance, Power & Space Savings with Intel® Solid State Drives

**Company:** Leading provider of on-demand software to telco, cable and hospitality operators, including video on demand for Telco IPTV operators

**IT Challenges**
- Optimizing number of video streams per server
- Video quality to end user over IP network
- Reduce total watts used per server

**Solution**
- Intel® Xeon 5500 series platform
- Intel® Solid-State Drives

**Results**
- 9 Gb/s of network throughput at less than 20% CPU utilization
- Achieve same throughput in 75% less space and about 75% less power

---

**Notes:**
1. Compared to previous generation Intel Xeon 5400 servers and standard HDDs

Customer savings and results are specific to the customer, its business goals and the configuration of its enterprise environment. Differences in business goals, software design, infrastructure or configuration may affect actual results.

* Other names and brands may be claimed as the property of others. Copyright © 2009, Intel Corporation.
Intel Optimization Strategy

Optimized Silicon
Optimized Technologies
Scalable Software
Optimized Systems
Datacenter Optimization

Intel focused on innovating and optimizing for cloud & internet datacenters

Value of Data Center Optimization

Assumptions
5 Mw IT load
$0.10/kW-hr
7x24 operation

Typical data center: PUE 2.0
• 10 Mw purchase from utility
• $8.8 million annual power bill

Best in class: PUE 1.4
• 7 Mw purchase from utility
• $6.1 million annual power bill

Net Savings of $2.7 million annually through increased efficiency

Source: Intel internal analysis, 2009
Driving Datacenter Efficiency

Operating Temp  Manageability  Compute Density

Power Delivery  PUE Methodology  Containers

Intel focused on advancing datacenter efficiencies in multiple areas of the datacenter

Summary

• Intel addressing the needs of “hyper-scale” Internet and cloud datacenters via optimization
  • Silicon, server boards & systems, technologies, software solutions, power management, datacenter level optimizations

• Intel® Xeon® 5500 processor series ideal foundation for Internet and cloud computing

• Talk with Intel on the specific needs of your infrastructure and how to take advantage of Intel’s optimized products and technologies